Designers Lighting Forum

Circularity and Digital Transformation – Zhaga-D4i Platforms

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INTRODUCTION

Zhaga Consortium – General Assembly Chair

Technical Advisor to U.S. TAG for IEC TC 34 and SC 34A

ANSI ASC C137 Lighting Systems Chair

DALI Alliance – NA Promotion WG member

35 years with GE Lighting and Current Lighting Solutions LLC

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Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Learning Objectives

At the end of this course, participants will be able to:

1. Recognize circularity economy opportunities for easy repair, upgrade and reuse when specifying Zhaga-D4i products from the multi-vendor database in smart lighting systems.

2. Appreciate the value of DALI digital control and D4i asset management in connected indoor and outdoor lighting systems.

3. Incorporate heritage and decorative luminaires in your smart city platform via the Zhaga Book 18, Edition 4.0 specifications.

4. Articulate the key aspects of the Zhaga Consortium Book 20 platform that supports smart buildings.

AGENDA

Introductions

Circular Economy – Zhaga-D4i

DALI Digital Control and D4i Asset Management

Smart City Platform – Zhaga Book 18, Edition 4.0

Smart Building Platform – Zhaga Book 20

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ZHAGA CONSORTIUM

An open global industry consortium with >560 members from the lighting industry that aims to standardize interfaces of components of LED luminaires, including LED light engines, LED modules, LED arrays, holders, LED drivers, connectors and sensing/communication modules.

ZHAGA Consortium

DALI ALLIANCE

The DALI Alliance (also known as the Digital Illumination Interface Alliance, or DiiA) is the global industry organization for DALI lighting control.

We are an **open, global consortium** of lighting companies, and our main aim is to grow the market for lighting-control solutions based on the standardized **Digital Addressable Lighting Interface (DALI)** protocol.

37   Regular Members
286 Associate Members
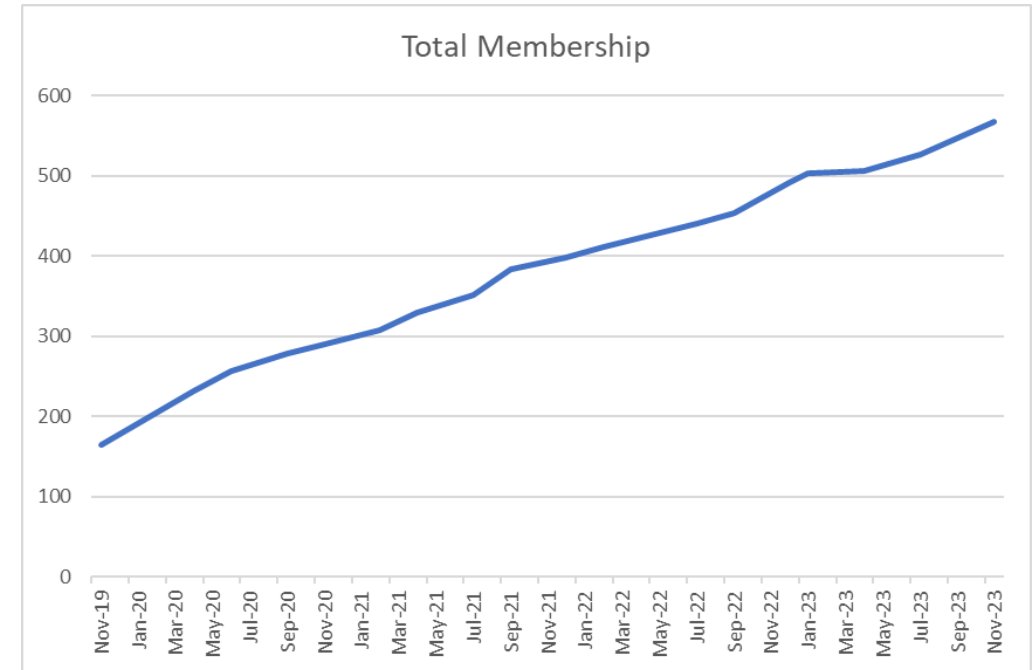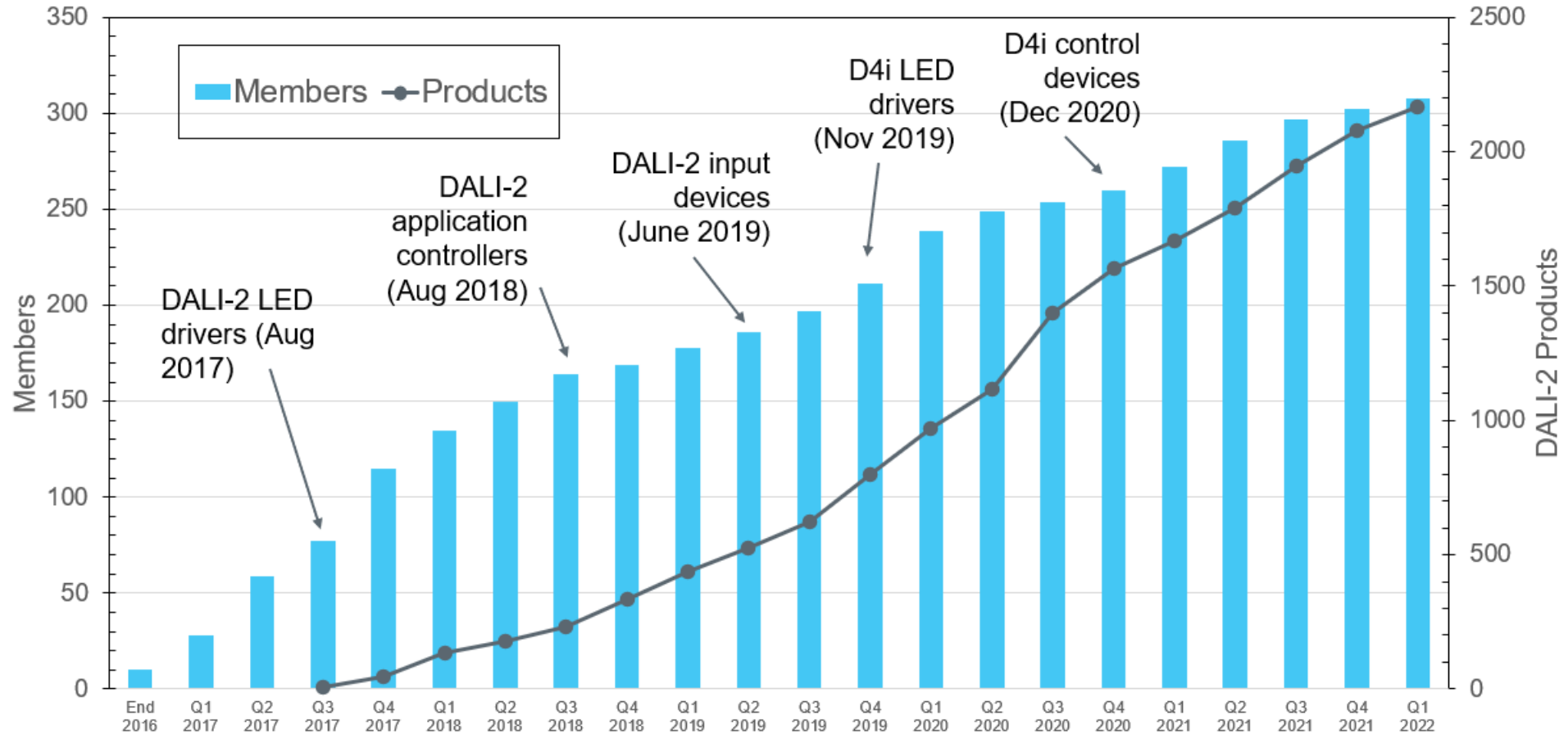56   Community Members

DALI ALLIANCE – MEMBERS & DALI-2 PRODUCTS

Join the digital transformation!!

CIRCULAR ECONOMY – ZHAGA-D4I

Learning objective 1:

Recognize circularity economy opportunities for easy repair, upgrade and reuse when specifying Zhaga-D4i products from the multi-vendor database in smart lighting systems.

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CIRCULARITY LIGHTING

A Circular Economy aims to…

- Limit consumption of resources and materials

- Avoid landfilling waste

"Circularity lighting encompasses products and systems that support the aims of the circular economy through enhanced serviceability. To be serviceable, these products and systems must be designed in a modular way and use component interfaces that are based on standardized and widely recognized specifications" – Armin Konrad, Senior Director at LEDVANCE GmbH

Serviceability requires LED luminaires and light management systems that are **repairable, upgradable, replaceable** and **durable.**

Zhaga standardizes interfaces of components of LED luminaires promoting a circular economy.

ZHAGA – D4I CERTIFICATION

A joint program from **Zhaga** and **DALI Alliance**

    Certification of interoperable luminaires and sensing or control devices and communication modules

Based on complementary specifications from Zhaga and DALI Alliance

    Zhaga **Book 18** or **Book 20** plus **D4i** specifications

Product certification allows the use of Zhaga and D4i logos

    For **luminaires, sensing or control** and **communication modules**

    Logos indicate **multi-vendor** product **interoperability**

    Creates a simple **plug-and-play** way of adding nodes to a luminaire

    Simplifies specification and tender process

    Allows selection of luminaires today that are **future-proof** to the technology advances of tomorrow

ZHAGA AND D4I INDIVIDUAL CERTIFICATIONS

Supporting the Zhaga – D4i ecosystem are certified specific products:

LED drivers are eligible for D4i certification from DALI Alliance

Book 18 **receptacles, bases and caps** and Book 20 **connectors** are eligible for certification from Zhaga

Look for
the logos!

FEATURES OF ZHAGA – D4I PRODUCTS

Easy to add or upgrade sensors and/or communication modules:

Enables future-proof luminaires that can keep pace with rapid developments in digital networking and sensing technology.

Intra-luminaire D4i interface:

Enables bi-directional communication between sensors and/or communication modules and LED drivers using the well-established and standardized DALI protocol.

D4i drivers are smart:

Able to report operational and diagnostic data to an external network, can provide inventory-related information about luminaires.

IoT connectivity:

With a suitable wireless communication module, the luminaire can interact with an external lighting-control network and to become part of the IoT.

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BENEFITS FOR DESIGNERS, SPECIFIERS AND END-USERS

Reduced risk and future-proofing

Zhaga-based luminaires are future-proof because light sources can be purchased from multiple suppliers.

Customer is not reliant on original supplier if maintenance and/or replacement is required.

Easier upgrades

Latest-generation technology can be adopted easily.

Luminaires are future-proofed against rapid LED technology evolution.

Circularity!

Avoiding installation/ specification of obsolete luminaires

Luminaires can be specified for future projects in the knowledge that a current, up-to-date LED light source can be fitted when the project is installed.

Unprecedented flexibility

Socket-able LED light sources enable tool-free interchangeability in the field. This allows different options for color temperature, CRI, and – in some cases – lumen levels
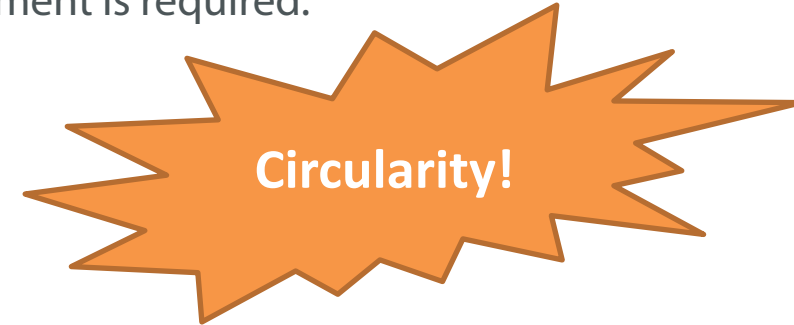
BENEFITS FOR DESIGNERS, SPECIFIERS AND END-USERS

Easier procurement

If maintenance or upgrades are necessary, standardized parts will be in stock from numerous suppliers.

Zhaga product database https://www.zhagastandard.org/products.html

Around 339 Zhaga-D4i luminaire families by more than 50 manufacturers

DALI Alliance product database https://www.dali-alliance.org/products

Over 400 D4i certified LED drivers from 26 suppliers

Specify with Confidence that…

| It works! | It's repairable! | It's upgradeable! | It's available! |

DALI DIGITAL CONTROL / D4I ASSET MANAGEMENT

Learning objective 2:

Appreciate the value of DALI digital control and D4i asset management in connected indoor and outdoor lighting systems.

DALI DIGITAL CONTROL + D4I: A COMPLETE VALUE

Complete Control

City-wide communication

Zoning

Task tuning

Adaptive streetlighting

Flexible scheduling

Energy Savings

Daylight responsiveness

Energy usage monitoring/reporting

Asset Management

LED driver model

Luminaire make & model

Manufacturing date code

HW & SW versions

Diagnostics and maintenance

Code Compliance

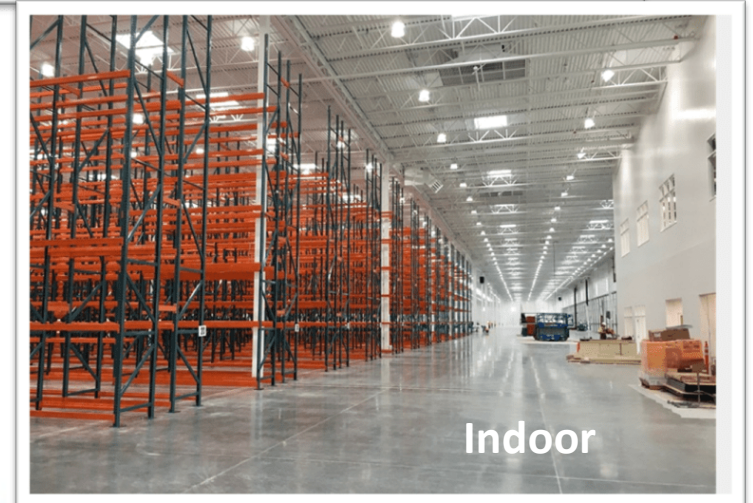Title 24 2022

ASHRAE 90.1 2022

IECC 2021

DLC Compliance

Energy Reporting

Cyber Security

Scheduling

Utility Rebates

Energy validation

Monitoring

Fault Detection

Notifications

Power and Cost

Power Saving Strategies

Outdoor

Indoor

ZHAGA – ASSET MANAGEMENT TOOLS

Zhaga Book 24 ED 1.1 (2022) *Programming of luminaire components using NFC*

- Easy production line NFC programming where multiple brand drivers are used one after the other
- Wireless programming using ISO 15693 standardized NFC protocol
- Luminaire specific parameters + vendor specific data

Zhaga Book 25 ED 1.0 (2022) *Programming of luminaire components using NFC readers with Bluetooth LE interface*

- Manufacturers develop own software and drivers
- OEMs/installers/maintenance use one setup to configure the drivers
- Smart device with vendor app enabling project specific settings
- Standardized Bluetooth
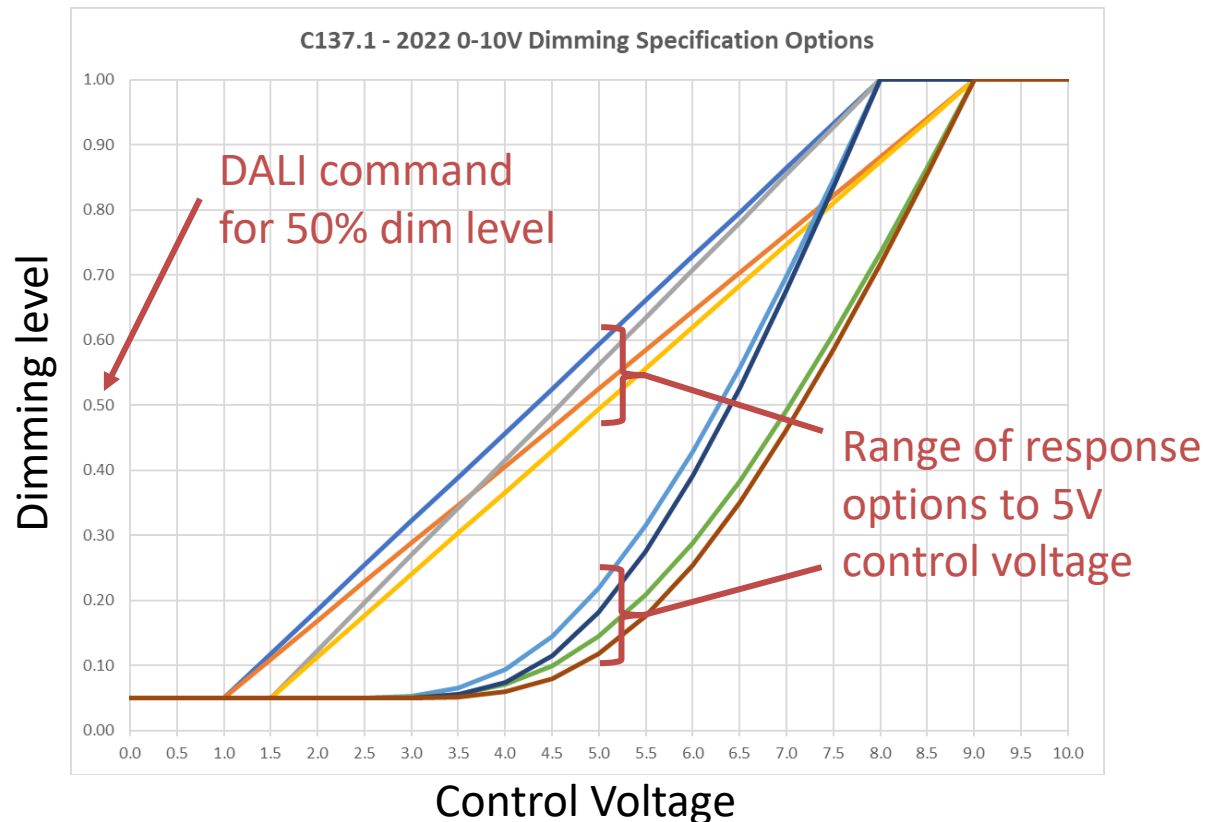- Wireless programming using ISO standardized NFC protocol
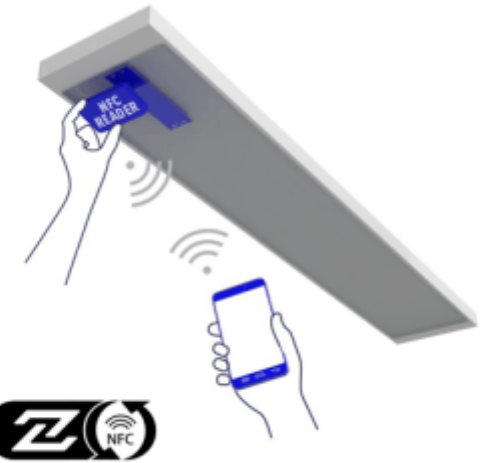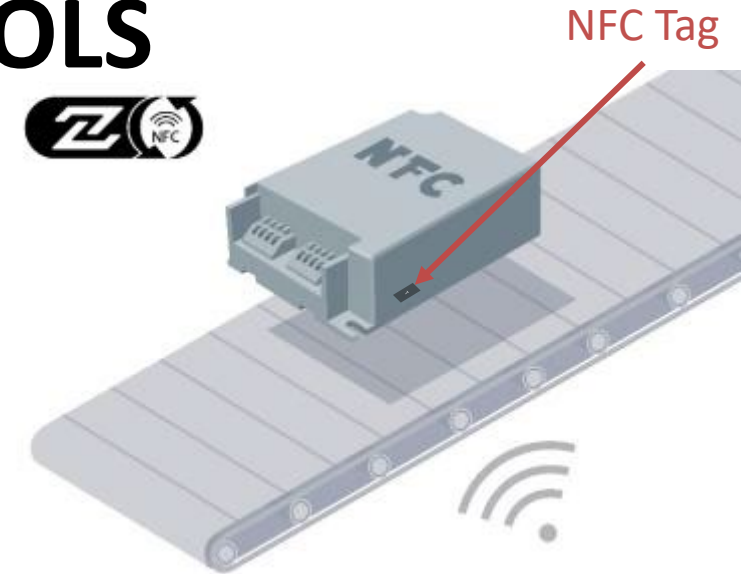
NFC Tag

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LIGHTING CONTROL STANDARDS – 0-10V

ANSI C137.1 – 2022 *0-10V Dimming Interface for LED Drivers, Fluorescent Ballasts, and Controls*

Specifies the 0-10 volt control interface method and performance requirements for dimmable LED drivers, fluorescent ballasts and dimming control units where output power is adjustable between minimum/off and maximum via a control input signal.

C137.1 - 2022 0-10V Dimming Specification Options

DALI command for 50% dim level

Range of response options to 5V control voltage

Dimming level

Control Voltage

Recommendations from PNNL researchers:

- Refine ANSI C137.1 to tighten up its requirements
- Characterize and calibrate 0-10V dimming curves and control signals in connected lighting systems
- Transition to standardized digital methods of control (such as **DALI D4i** or ANSI C137.4–2021)

Source: LEDs Magazine *"Evaluating energy impacts of 0–10V control in outdoor lighting"*

Jason Tuenge, Shat Pratoomratana, Anay Waghale, Michael Poplawski

https://www.ledsmagazine.com/print/content/14299510

See also: energy.gov/eere/ssl

PNNL-32949 November 2023

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LIGHTING CONTROL STANDARDS – DIGITAL

ANSI C137.4 – 2021 *Interoperability of LED Drivers and Other Connected Devices Via the Digital Addressable Lighting Interface*

- This standard specifies the minimum requirements for devices such as drivers, AUX power supplies, controls, sensors, luminaire mounted control devices, and communication devices **supporting a digital interface between devices**.

- This standard builds on the **DALI digital addressable lighting interface** as specified in the IEC 62386 series of standards to specify the requirements for memory bank usage, logic signal interface, energy reporting, diagnostic information, as well as requirements for auxiliary power supplies that may be integrated into an LED driver.

- Products that are compliant with ANSI C137.4-2021 may be eligible to apply for **D4i certification**.

DiiA Specification	D4i certification requirement	Included in ANSI C137.4	
		2019	2021
LED DRIVERS			
DALI Part 150 – AUX Power Supply	Optional	✓	✓
DALI Part 250 – Integrated Bus Power Supply	Mandatory	✓	✓
DALI Part 251 – Luminaire Data (Memory Bank 1)	Mandatory	✓	✓
DALI Part 252 – Energy Data	Mandatory		✓
DALI Part 253 – Diagnostics Data	Mandatory		✓
CONTROL DEVICES			
DALI Part 351 – Luminaire-mounted control devices	Mandatory		✓

LIGHTING CONTROL STANDARDS – DALI

DALI-2 and D4i for Interoperability

- DALI digital input is numeric, the **input signal has no uncertainty** which leads to reduced variation in the output performance.

- DALI digital input **easily communicates between different control characteristics**: dimming, color, dim-to-warm, etc. A 0-10V control system needs dedicated inputs for each control characteristic.

- DALI digital communication is **more versatile** supporting a large variety of sensor devices: presence detectors, light sensors, color sensors, etc.

- DALI digital addressing allows for setting up various **groups of luminaires** that respond together.

- DALI D4i assists in **luminaire data, energy monitoring and reporting, diagnostics and maintenance**. These features need to be provided separately in proprietary 0-10V control systems.

DALI FREQUENTLY-ASKED QUESTIONS

Tips for specifiers, ESCOs, retailers…

- **What advice should I know when using D4i certified drivers in wired DALI networks?**

  - Disable DALI power supply on each driver. Use a separate DALI bus power supply or a power supply built into the controller.

  - Maintain DALI wiring polarity for the entire installation. Connect DA+ to DALI +, and DA- to DALI -.

  - No mis-wiring of DALI terminals to AC mains. Such miswiring will damage the driver.

  - Verify DALI-2 certification of controllers.

  - The DALI controller manufacturer must verify interoperability. Normally the network size is limited to 64 drivers per single DALI bus.

- **How can I use multiple D4i luminaires in wired DALI systems?** To use multiple D4i luminaires together in the same DALI system, ensure the maximum bus power supply current of 250mA will not be exceeded. If more luminaires are connected, then one or more of the bus power supplies will need to be disabled. For D4i drivers, this can be done using a programming tool before connecting the luminaire's DALI bus into the larger system.

DALI FREQUENTLY-ASKED QUESTIONS

Tips for specifiers, ESCOs, retailers…

- **What is DALI-2 Certification?** The DALI-2 certification program is based on the latest version of the DALI protocol and involves verification of test results by DiiA. In contrast, DALI version-1 compliance testing was based on self-declaration without verification of results. As well as covering many different product types, including control devices (e.g., input devices and application controllers), DALI-2 certification offers the promise of improved interoperability of products from different manufacturers.
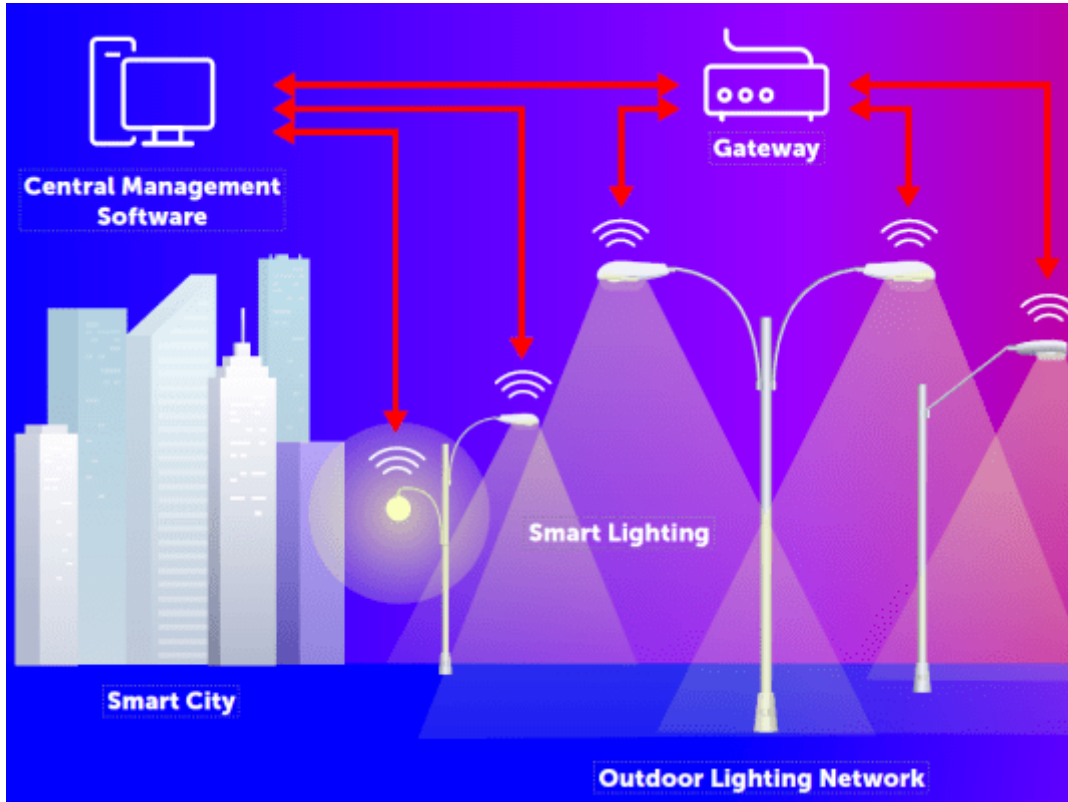

Visit the website for more FAQ: https://www.dali-alliance.org/about-us/faqs.html

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SMART CITY PLATFORM – ZHAGA BOOK 18, EDITION 4.0

Learning objective 3:

Incorporate heritage and decorative luminaires in your smart city platform via the Zhaga Book 18, Edition 4.0 specifications.
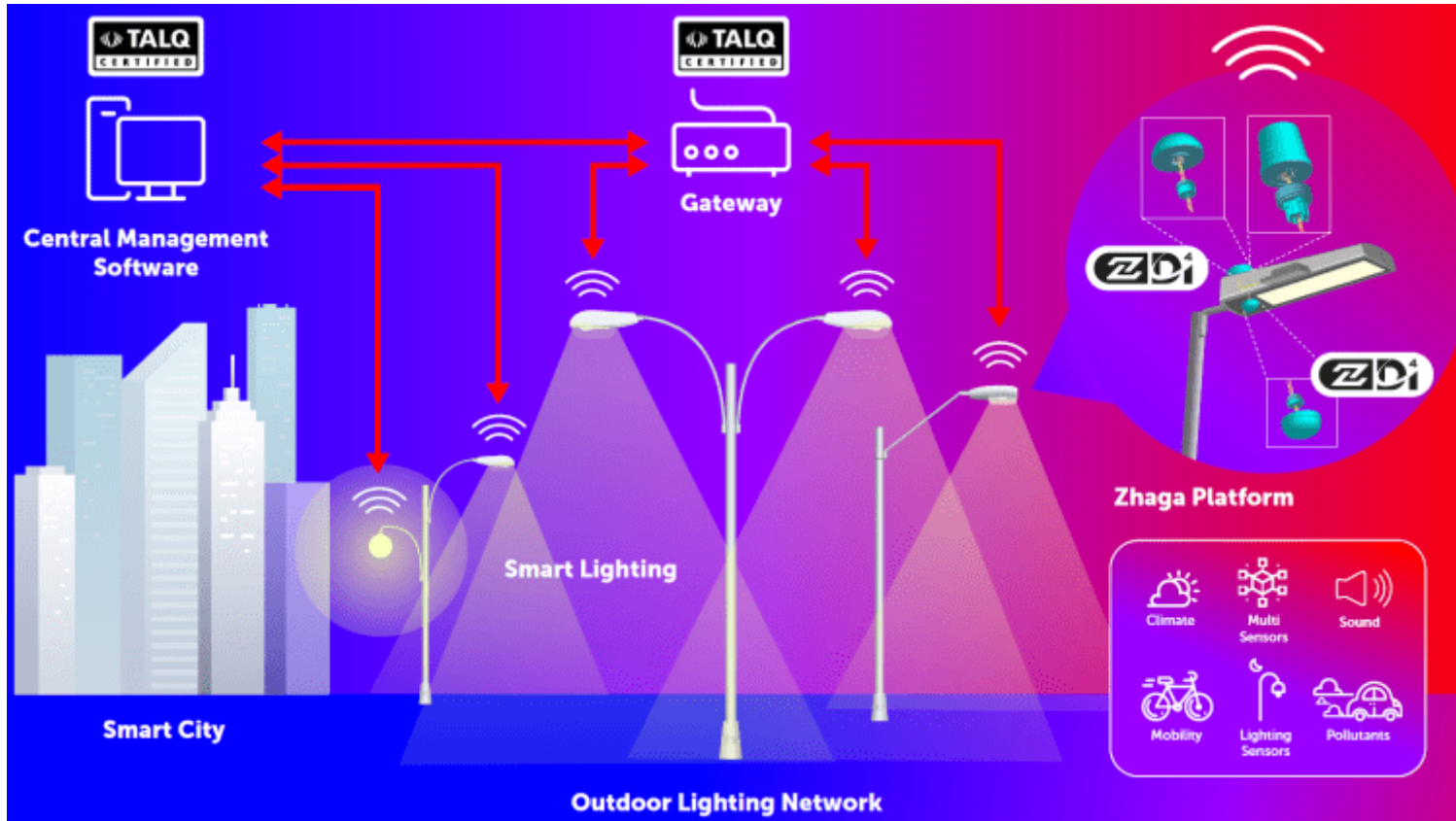
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SMART CITIES – BIG PICTURE

Layers of a smart city

- Smart City Controller
- Lighting Systems
    - Central Management System (CMS)
    - Gateways
    - Communication modules (NLC)
    - Luminaires
    - Sensors

SMART CITY COMMUNICATION PROTOCOLS

- Central Management Software: TALQ Application Programming Interface (API)

- Systems use a large variety of wireless networks: 3G/4G/5G, NB-IoT, LoWPAN, WiSUN, UNB, LoRa, proprietary, etc.

- Lighting Systems: DALI-2, D4i

ZHAGA PLATFORM – BOOK 18 ED 3.0

Vision for Smart Cities

Hybrid Luminaires

Hybrid architecture "NEMA" and Zhaga receptacles available on the same luminaire
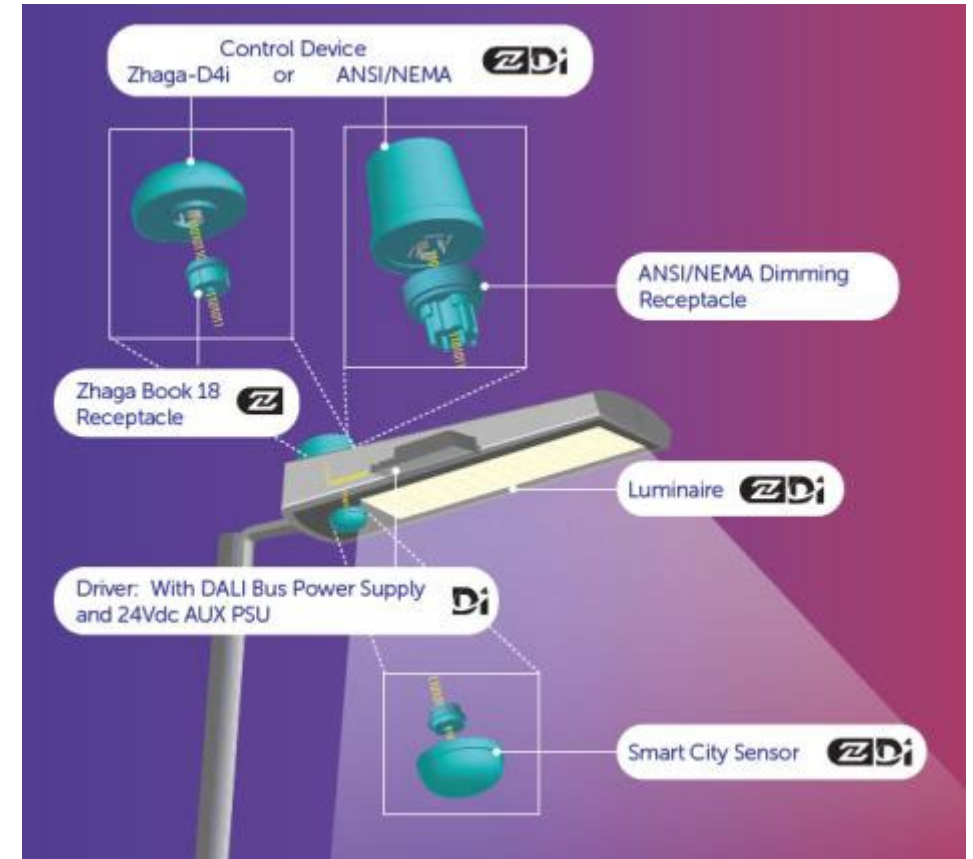
Control

Power

ON/OFF operation

Dimming function

Add networking…

Connection to IoT

City-wide communication

Energy usage monitoring/reporting

Add sensors…

Environmental sensing (weather, air quality, smoke)

Area security monitoring (surveillance cameras, noise detection)

Vehicular and pedestrian traffic detection

Emergency response

Parking space assistance

ZHAGA PLATFORM – BOOK 18 ED 4.0

Decorative Charm for Smart Cities

- Zhaga Book 18 ED 1 – ED 3 covered luminaires with available horizontal surfaces

- Decorative and heritage luminaires need mounting surfaces for lighting controls

- Bracket assembly
  - Pole mounted
  - Available as a retrofit option to existing luminaires

- One or two Zhaga 4-pin electro-mechanical interfaces

- The specification addresses installation and the long cables needed to connect the bracket assembly with the luminaire D4i drivers, including surge protection and DALI timings.

ZHAGA PLATFORM – BOOK 18 ED 4.0

Proposed Basic Architecture

- Luminaire
  - Zhaga Book 18 receptacle (LEX-R) supporting up to 1 luminaire extension module (LEX-M)
  - Surge protection device (not shown)
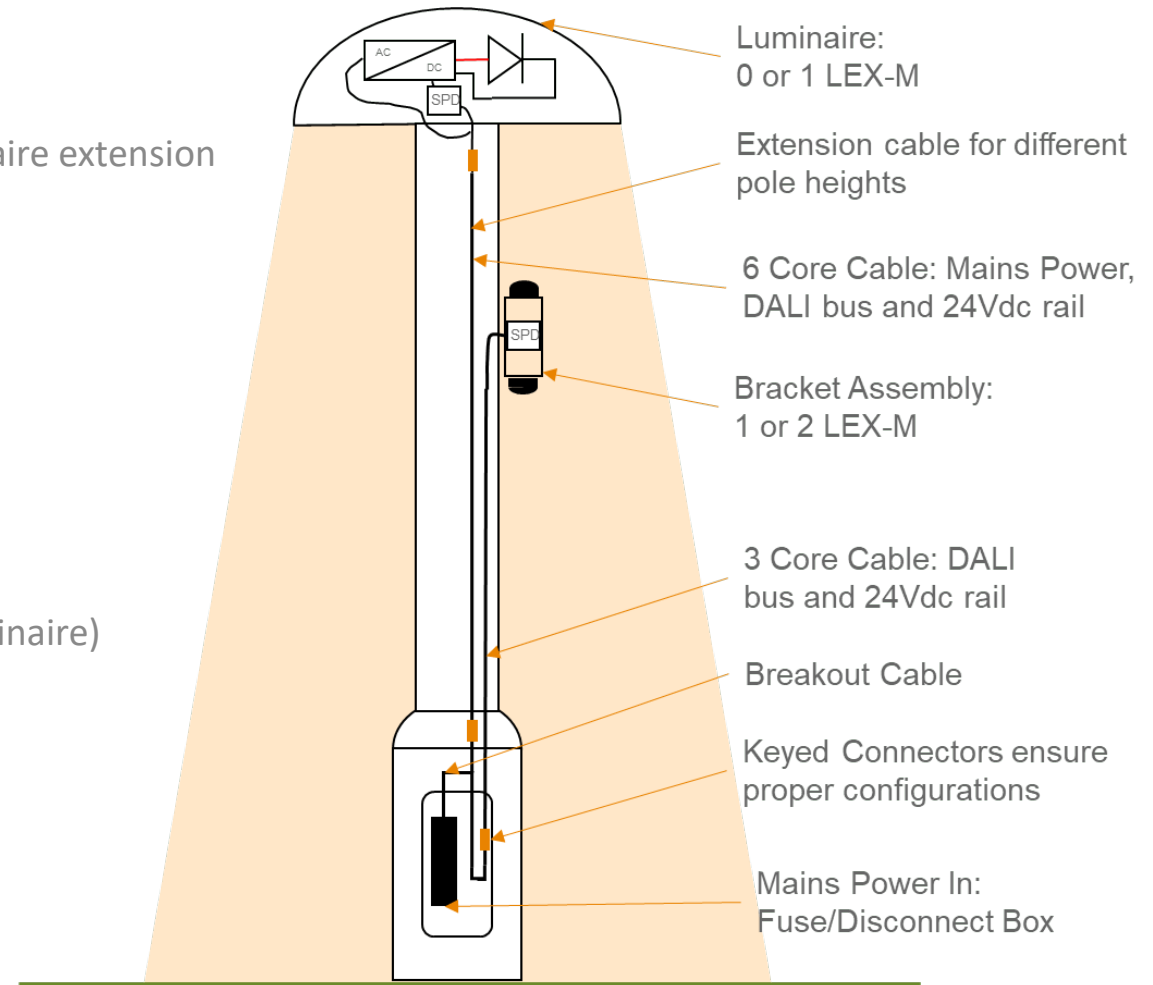 - DALI D4i driver
- Bracket Assembly
  - Pole mounted
  - Zhaga Book 18 receptacles (LEX-R) supporting 1 or 2 LEX-M
  - Surge protection device (not shown)
- Cables
  - 6-Core Cable: Mains power, DALI bus and 24 V_{dc} rail (to luminaire)
  - 3-Core Cable: DALI bus and 24 V_{dc} rail (to bracket)
  - Customized lengths for different pole heights
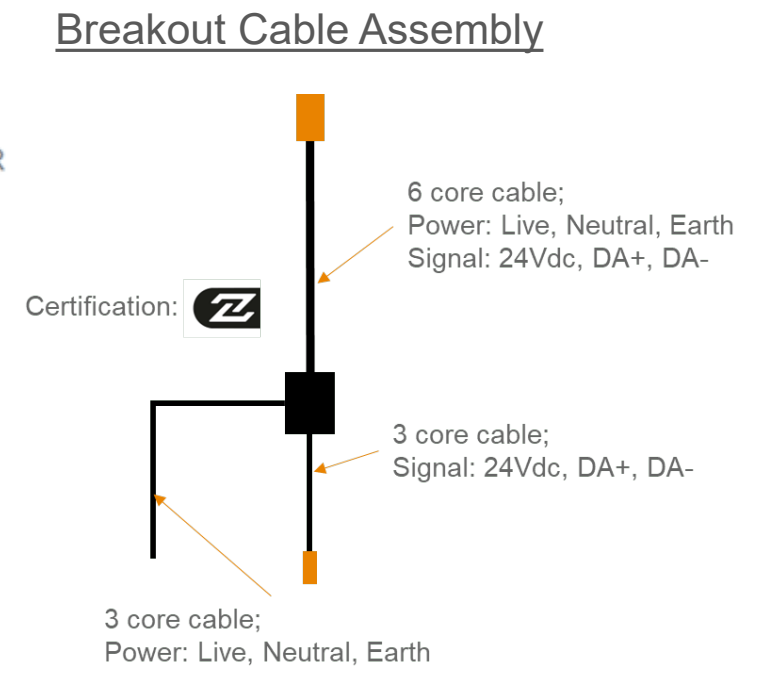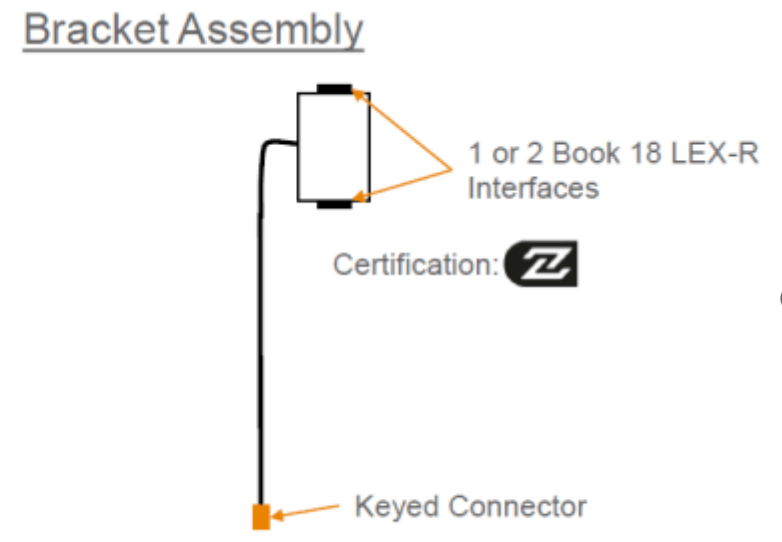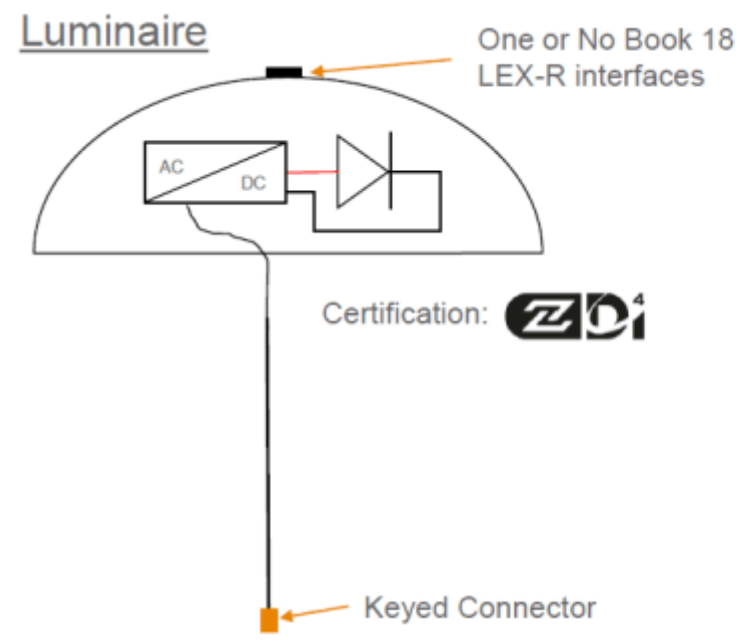 - Breakout Cable: 6-Core to two 3-Core cables
- Connectors
  - 6-contact plug and receptacle
  - 3-contact plug and receptacle
  - Keyed to ensure proper configurations

Luminaire:
0 or 1 LEX-M

Extension cable for different pole heights

6 Core Cable: Mains Power, DALI bus and 24Vdc rail

Bracket Assembly:
1 or 2 LEX-M

3 Core Cable: DALI bus and 24Vdc rail

Breakout Cable

Keyed Connectors ensure proper configurations

Mains Power In: Fuse/Disconnect Box

ZHAGA PLATFORM – BOOK 18 ED 4.0

Three Certifiable Products

Luminaire

One or No Book 18 LEX-R interfaces

AC / DC

Certification: Z D⁴

Keyed Connector

Bracket Assembly

1 or 2 Book 18 LEX-R Interfaces

Certification: Z

Keyed Connector

Breakout Cable Assembly

6 core cable;
Power: Live, Neutral, Earth
Signal: 24Vdc, DA+, DA-

Certification: Z

3 core cable;
Signal: 24Vdc, DA+, DA-

3 core cable;
Power: Live, Neutral, Earth

SMART BUILDING PLATFORM – ZHAGA BOOK 20

Learning objective 4:

Articulate the key aspects of the Zhaga Consortium Book 20 platform that supports smart buildings.

SMART BUILDINGS – BIG PICTURE

Layers of a smart building

- Building Management System (BMS) – Data analysis, energy and functional optimization
  - HVAC
  - Security System
  - Emergency System
  - Lighting System
    - Luminaires
    - DALI D4i drivers – Energy monitoring/reporting
    - Sensors
    - Communication modules
    - Asset management
  - Fenestration System
  - IoT Applications

ZHAGA PLATFORM – BOOK 20 ED 1.2

Vision for Smart Buildings

Luminaire with Control
Power
ON/OFF operation
Dimming function

Add networking…
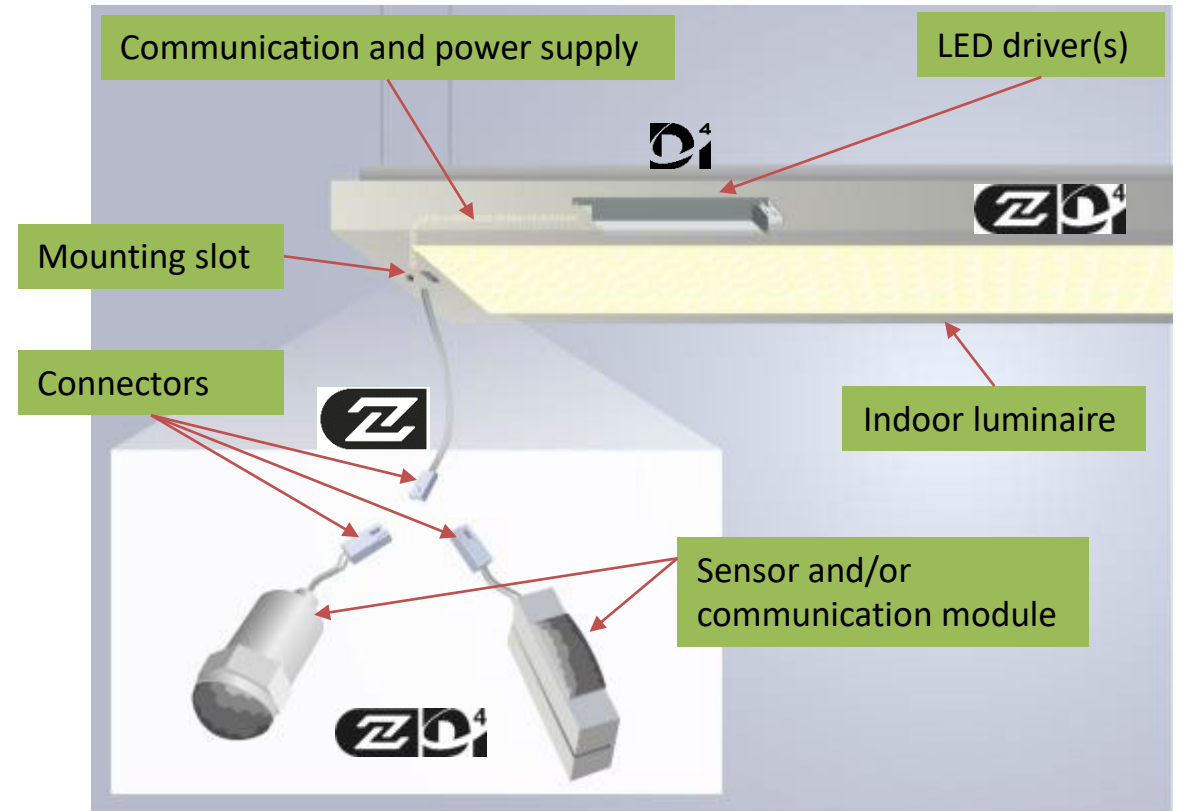Building CMS
Energy monitoring and reporting
Illumination control (spectrum, scenes, etc.)

Add sensors…
Presence sensing
Daylight harvesting
Security
Emergency response
Hazard detection

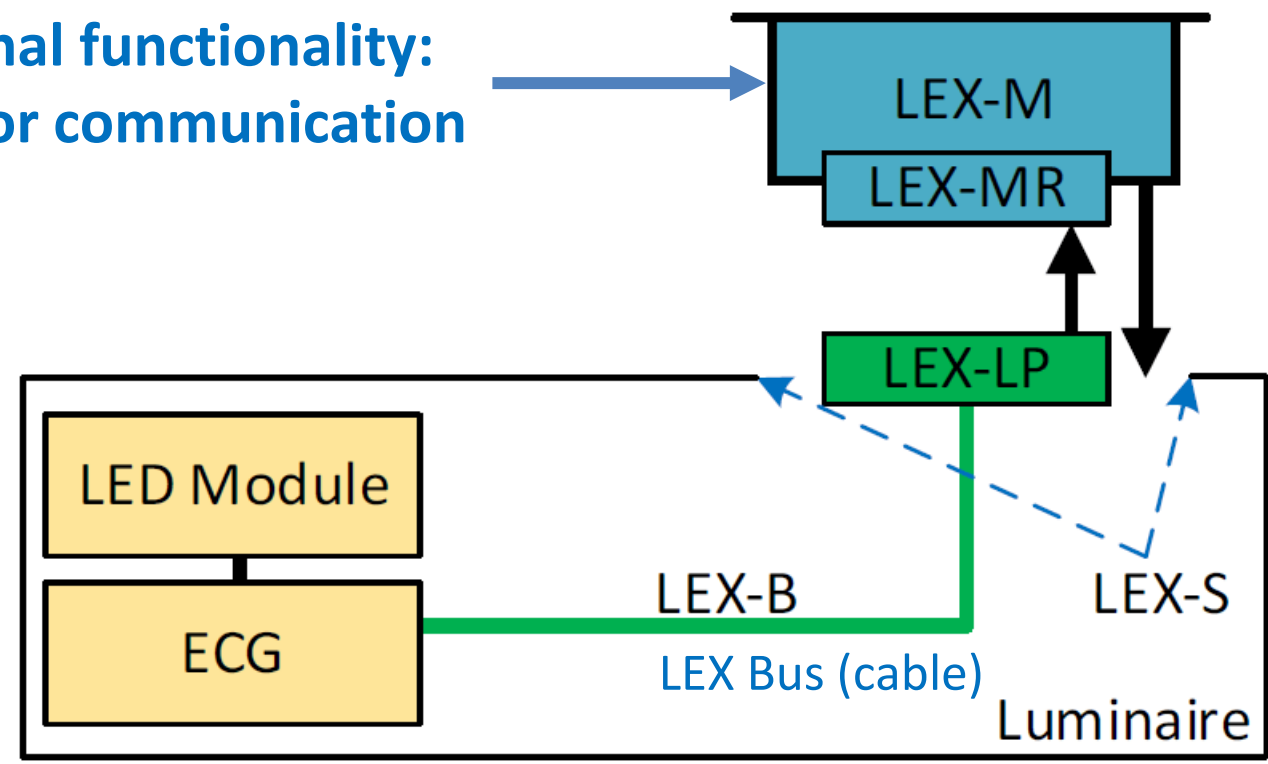**Publicly available…** www.zhagastandard.org
Check out the video: https://youtu.be/qAF4FymbUJw

Communication and power supply

LED driver(s)

Mounting slot

Connectors

Indoor luminaire

Sensor and/or communication module

ZHAGA PLATFORM – BOOK 20 ED 1.2

Indoor Connectivity System Overview

Luminaire Extension (LEX)

Additional functionality:
Sensor or communication

LEX Module

LEX-M

LEX-MR

LEX Module Receptacle

LEX-LP

LEX Luminaire Plug

LED Module

ECG

LEX-B

LEX-S

LEX Slot

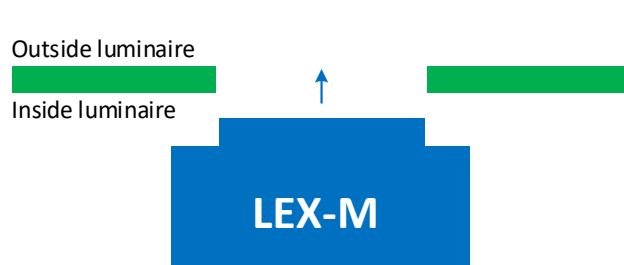Electronic Control Gear
(LED Driver)

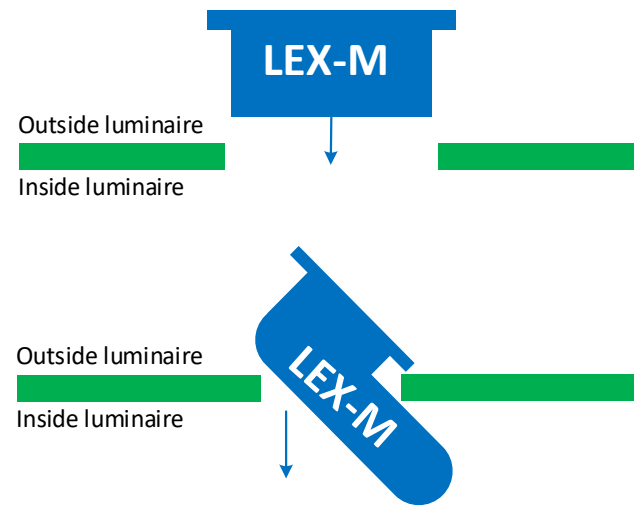LEX Bus (cable)

Luminaire

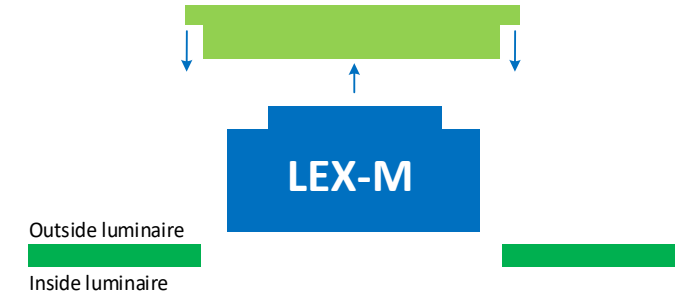leducation.org

ZHAGA PLATFORM – BOOK 20 ED 1.2

Fitting system configurations – LEX Module to LEX Slot

Module is mounted from the inside of the luminaire into the slot

Module is mounted from the outside of the luminaire into the slot

Module is mounted from the outside of the luminaire using a bracket fitting into the slot

ZHAGA PLATFORM – BOOK 20 ED 1.2

LEX Module to LEX Slot – Mechanical Interfaces

Rectangular

R44x17 (44 x 17 mm) (~1.7 x 0.7 in)

→ Rectangular modules with small volumes and indifferent orientation

R60x22 (60 x 22 mm) (~2.4 x 0.9 in)

→ Rectangular modules requiring more volume and surface, e.g., gas detectors or complex presence detectors

LEX-M

ZHAGA PLATFORM – BOOK 20 ED 1.2

LEX Module to LEX Slot – Mechanical Interfaces

Circular

C22-T1A (Ø 22 mm) (~0.9 in)
→ Cylindrical modules as already widely used in the field, adjustable orientation, minimum surface

C22-T1B (Ø 22 mm) (~0.9 in)
→ Cylindrical modules as already widely used in the field, adjustable orientation, larger lenses

C22-T2 (Ø 22 mm) (~0.9 in)
→ L-shaped modules enable ultra-flat luminaire designs

LEX-M

LEX-M

LEX-M

LEX-LP

LEX-MR

Wire-to-wire

ZHAGA PLATFORM – BOOK 20 ED 1.2

Connector Features

Two position plug and receptacle interface

Easy to use separable connection provides reliable DALI connectivity

Poka Yoke features prevent incorrect mating.

Enables connection with polarity ensured

Connector provides finger proof protection

Housing provides touch proof protection for separable contacts

Plug & play functionality can be installed by a generalist

Does not require a specialist to upgrade luminaire functionality

Integrated latch feature provides 5N minimum retention when mated

Slim profile latch ensures that connectors remain intact over its lifetime

Wire-to-board
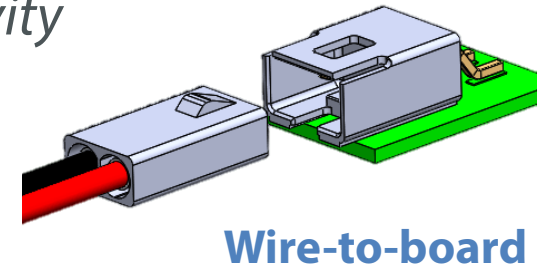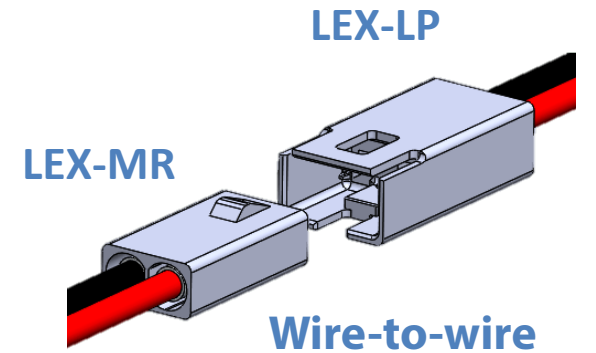
ZHAGA PLATFORM – BOOK 20 ED 1.2

Electrical & Communication Interface

DALI Communication & DALI Bus Power

Luminaire – LEX Luminaire Plug (LEX-LP)

Installed non-emergency LED drivers connect to the LEX-B.

No DALI application controllers or DALI input devices as specified in DALI - Part 103

No provisions for connection to an external DALI bus. However, terminals allowing for connection to segments that enable a modular assembly of a luminaire are permitted if there are a maximum of 4 segments connected via DALI, each containing one LED driver.

At the LEX-LP interface, the guaranteed supply current provided shall be at least 48 mA and the maximum supply current shall not exceed 250 mA.

LEX Module (LEX-M)

The LEX-M shall meet the requirements for a Type C control device, or a bus powered Type D control device as specified in DALI-part 351 (Luminaire mounted control devices).

The LEX-M shall be listed as D4i certified in the DiiA database.

For additional requirements and information see Book 20

ZHAGA BOOK 20 AND DALI D4I – BUILDING LIGHTING CONTROL

U.S. Department of Energy – L-Prize competition

Efficacy

Quality of Light

Connectivity

Product Life Cycle

Technical Innovation

Diversity, Equity, and Inclusion

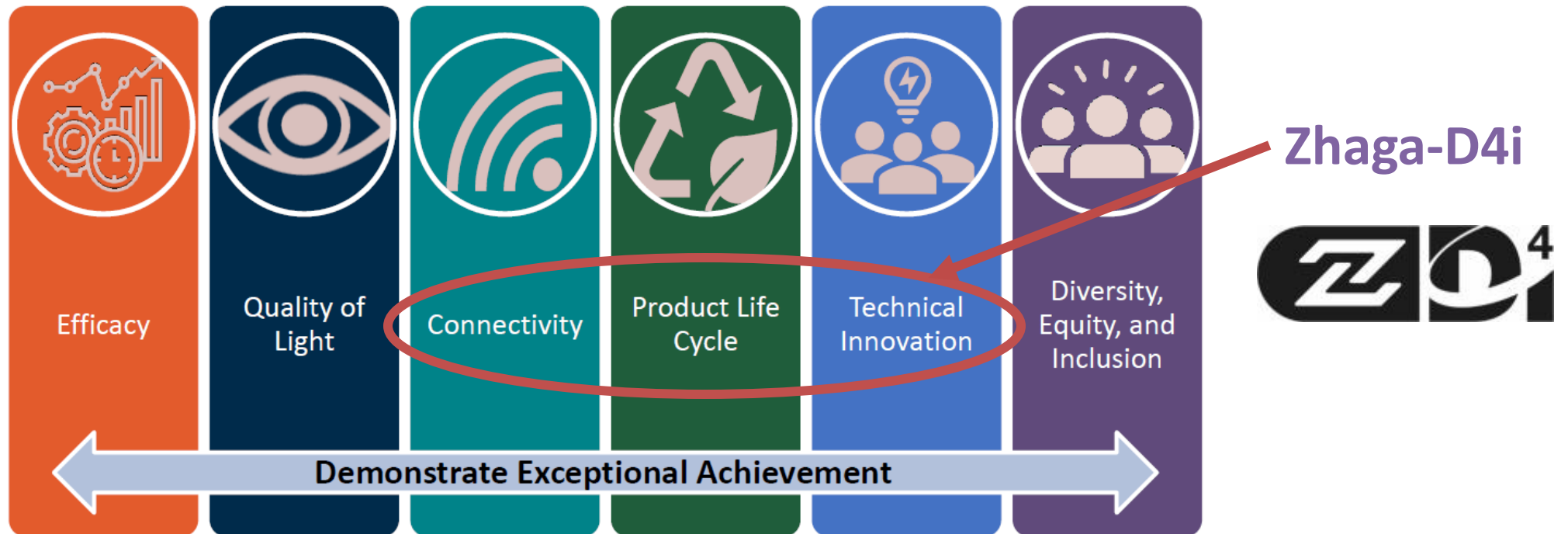Demonstrate Exceptional Achievement

Zhaga-D4i

Figure 1: The L-Prize aims for interoperable lighting systems that demonstrate exceptional achievement across six distinct categories.

U.S. DEPARTMENT OF ENERGY – L-PRIZE COMPETITION

Contest	Winners	Prizes
Concept Phase (complete)	4 were awarded	$20,000 per winner
Prototype Phase (complete)	6 were awarded	$2 million pool
Manufacturing and Installation Phase	Up to 4	$10 million pool

You are here now!!

PROTOTYPE PHASE WINNERS

U.S. Department of Energy – L-Prize competition

Zhaga Book 20 Ed 1.2 (May 2022) and DALI D4i data and control

Congratulations to the Prototype Phase winners using certified Zhaga-D4i products in their lighting control projects!!

(see www.americanmadechallenges.org/challenges/lprize)

THANK YOU → JOIN DALI!!

Website: https://www.dali-alliance.org/

Digital Addressable Lighting Interface:
The global standard for smart lighting control

The DALI Alliance is the global industry organization for DALI®, the internationally-standardized protocol for digital communication between lighting-control devices.

Multiple membership options available
Regular
Associate
Community

THANK YOU → JOIN ZHAGA!!
Website: https://www.zhagastandard.org/

Zhaga creates interface standards for components in LED luminaires

Zhaga interface standards future proof your luminaire through interoperability for connected, serviceable and sustainable lighting

Multiple membership options available

Regular

Associate

Community

Mark Duffy
Chair of Zhaga General Assembly
lightingmd35@gmail.com

This concludes The American Institute of Architects Continuing Education Systems Course

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